

CLAIMS

It is claimed:

- Sub A1
1. A germicidal lamp for harsh environments adapted to be mounted on a wall, the wall having an insertion opening, the germicidal lamp comprising:
 - a low pressure germicidal tube which, when energized, emits UVC without substantial ozone and can withstand skin-effect cooling, the tube including an envelope and a stem; and
 - a fixture comprising a cover, a base and a tube-holder, wherein
 - the base has an upper surface and a lower surface,
 - the lower surface of the base seals against the wall to thereby prevent splashing water, hose-directed water, ice formations, wind, dirt, rain and environmental corrosion to pass there through,
 - the cover is at least partially detachable from the base so that the cover can be moved from a first position wherein the cover covers the upper surface to a second position wherein the cover is at least partially separates from the base to at least partially expose the upper surface of the base,
 - the cover and the upper surface of the base define an interior space within the fixture,
 - the cover seals tightly to the base to thereby prevent splashing water, hose-directed water, ice formations, wind, rain and environmental corrosion from entering the interior space of the fixture,
 - the base includes an opening through which the envelope of the tube is passed for installation of the tube in the fixture and removal of the tube from the fixture,
 - installation of the tube seals the opening in the base of the fixture from air flow into the fixture,
 - a tube-holder including an engaging surface adapted to engage and secure the stem of the tube,
 - after the envelope has been inserted through the opening in the base of the fixture,

28 the cover and the base include exterior surfaces which are resistant to
29 splashing water, hose-directed water, ice formations, wind, rain and environmental
30 corrosion.

1 2. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the tube comprises an elongate hollow cylinder.

1 3. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the tube is adapted such that UVC output from the tube peaks when an
3 air flow of between 200 cfm and 600 cfm at between 30°F and 65°F is passed across the
4 tube.

1 4. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 3 wherein the tube is adapted such that UVC output from the tube peaks when an
3 air flow of 400 cfm at 55°F is passed across the tube.

1 5. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the tube emits UVC of at least $10\text{-}\mu\text{W}/\text{cm}^2$ per inch arc length at one
3 meter when an airflow of between 100 and 800 cfm is passed across the tube.

1 6. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the tube emits UVC of at least $10\text{ }\mu\text{W}/\text{cm}^2$ per inch arc length at one
3 meter when an air flow of between 0°F and 70°F is passed across the tube.

1 7. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 having a weight of less than two lbs.

1 8. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the cover and the base of the fixture are separable.

1 9. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the cover and the base of the fixture have a clamshell design.

1 10. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the base of the fixture includes the tube-holder.

1 11. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 10 wherein the tube-holder comprises a spring clamp attached to the upper surface
3 of the base of the fixture around the opening in the base, the spring clamp comprising a
4 spring, a mount and two stops, the spring comprising wire in a substantially flat U shape,
5 the stem of the spring's U being fixed by the mount to the upper surface of the base
6 adjacent the opening such that the arms of the U are disposed on opposite sides of the
7 opening, the mount allowing the spring to rotate such that the spring can be pivoted about
8 the mount between a position substantially parallel to the upper surface to a position
9 substantially perpendicular to the upper surface, the stops holding the spring in
10 compression and parallel to the upper surface, wherein the spring clamp wraps at least
11 partially around the stem of the tube and presses the stem against the upper surface of the
12 base of the fixture and thereby holds the tube in place and the tube in the fixture.

1 12. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the tube-holder is attached to the cover of the fixture, wherein the tube-
3 holder is positioned in the cover such that, when the cover is closed onto the base of the
4 fixture, the tube-holder also engages the stem of the tube and holds the tube firmly in
5 place.

1 13. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 1 wherein the tube-holder includes an electrical connector which engages at least
3 one electrode in the stem of the tube when the tube-holder engages the stem.

Sub A21 14. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the plural seals are further adapted to be seated around the opening in the base to thereby prevent splashing water, hose-directed water, ice formations, wind, dirt, rain and environmental corrosion to pass there through.

15. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 wherein the seals between the fixture and the wall can withstand air pressure of at least 15 inches of water gage.

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16. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1, ^{the} cover and the base of the fixture defining an interior space, the fixture further comprising a power supply adapted to convert an input power source into a form appropriate for the tube.

17. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1 further including an electrical connector disposed within the fixture adapted to electrically engage the stem of the tube, the germicidal lamp further including plural electrical leads attached to the electrical connector and extending outside of the fixture, the leads including piggyback connectors adapted to be connected to an air conditioner's power or fan controller, whereby other connectors on the controller can be removed from the controller and attached to the piggyback connector, and the piggyback can then be attached to the controller in place of the other connector.

Sub A3 18. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1, wherein the seals between the tube and the fixture can withstand air pressure of at least 30 inches of water gage.

19. The germicidal lamp for harsh environments adapted to be mounted on a wall of claim 1, wherein the seals between the cover and the base can withstand air pressure of at least 20 inches of water gage.

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1 20. An air handling system comprising the germicidal lamp of claim 1.

1 21. An HVAC system comprising the germicidal lamp of claim 1.

1 22. A germicidal lamp for harsh environments comprising:

2 a single-walled tube having a stemmed end and a free end and comprising

3 an envelope disposed between the ends having a first cross-sectional
4 shape,

5 a rigid stem secured to the envelope at the stemmed end, the stem
6 including at least one electrode; and

7 a fixture comprising:

8 a base having an upper surface and a lower surface, the base including an
9 opening through which the envelope of the tube is passed for installation of the tube in
10 the fixture and removal of the tube from the fixture, but through which the stem will not
11 fully pass, the lower surface of the base sealing against a wall to thereby prevent
12 splashing water, hose-directed water, ice formations, wind, rain and environmental
13 corrosion to pass there through, the base including an exterior surface which is resistant
14 to splashing water, hose-directed water, ice formations, wind, rain and environmental
15 corrosion;

16 a socket disposed inside of the fixture and electrically coupled to at least
17 one electrode;

18 a cover which is at least partially detachable from the base so that the
19 cover can be moved from a first position wherein the cover covers the upper surface and
20 the cover can be at least partially moved away from the base to at least partially expose
21 the upper surface of the base, the cover sealing tightly to the base to thereby prevent
22 splashing water, hose-directed water, ice formations, wind, rain and environmental
23 corrosion from entering the interior space of the fixture, the cover including an exterior
24 surfaces which is resistant to splashing water, hose-directed water, ice formations, wind,
25 rain and environmental corrosion;

26 a tube-holder including an engaging surface adapted to engage and secure
27 the stem of the tube.

1 23. The germicidal lamp for harsh environments of claim 22, the tube-holder
2 comprising a spring clamp coupled to the primary wall around the opening, the spring
3 clamp comprising a spring, a mount and two stops, the spring comprising wire in a
4 substantially flat U shape, the stem of the spring's U being fixed by the mount to the first
5 wall adjacent the through-hole such that the arms of the U are disposed on opposite sides
6 of the through-hole, the mount allowing the spring to rotate such that the spring can be
7 pivoted about the mount from a position substantially parallel to the first wall to a
8 position substantially perpendicular to the first wall, the stops holding the spring in
9 compression and parallel to the first wall;
10 wherein the spring clamp wraps at least partially around the stem and presses the
11 stem into the primary wall and thereby holds the tube in place.

1 24. The germicidal lamp for harsh environments of claim 22 wherein the tube
2 comprises a low pressure germicidal tube which, when energized, emits UVC without
3 substantial ozone and can withstand skin effect cooling in an air flow of between 200 cfm
4 and 600 cfm at between 30°F and 65°F.

1 25. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 22 wherein the tube emits UVC of at least $10\text{-}\mu\text{W}/\text{cm}^2$ per inch arc length at one
3 meter when an airflow of between 100 and 800 cfm is passed across the tube.

1 26. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 22 wherein the tube emits UVC of at least $10\text{ }\mu\text{W}/\text{cm}^2$ per inch arc length at one
3 meter when an air flow of between 0°F and 70°F is passed across the tube.

1 27. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 22 having a weight of less than two pounds.

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1 28. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 22 wherein the seals between the fixture and the wall can withstand air of at least
3 15 inches of water gage.

1 29. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 22, wherein the seals between the tube and the fixture can withstand air pressure of
3 at least 30 inches of water gage.

1 30. The germicidal lamp for harsh environments adapted to be mounted on a wall of
2 claim 22, wherein the seals between the cover and the base can withstand air pressure of
3 at least 20 inches of water gage.

1 31. An air handling system comprising the germicidal lamp of claim 22.

1 32. An HVAC system comprising the germicidal lamp of claim 22.